

**BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT**

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code 

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Fifth Semester B.E. Degree Examinations, September/October 2024

**AUTOMATA THEORY AND COMPILER DESIGN**

Duration: 3 hrs

Max. Marks: 100

**Note:** 1. Answer any FIVE full questions choosing ONE full Question from each Module.

2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBT:CO:PI)</u>																				
<b><u>Module-1</u></b>																							
1.	<p>a. Describe the following terms with examples: (i) Alphabet (ii)String (iii)Language (iv)Power of Alphabet (v)<math>\Sigma^*</math> (sigma closure)</p> <p>b. Design DFA for the following languages: (i)<math>L = \{w \in \{a,b\}^* \mid \text{string } w \text{ end with substring } abb\}</math> (ii)<math>L = \{w \in \{0,1\}^* \mid \text{string } w \text{ begins with } 01 \}</math> (iii)<math>L = \{w \in \{0,1\}^* \mid \text{string } w \text{ contains substring } 01 \}</math></p> <p style="text-align: center;"><b>(OR)</b></p>	10	(2 : 1 : 1.7.1)																				
2.	<p>a. Describe any four applications of automata theory. Define deterministic Finite Automata.</p> <p>b. Convert the following <math>\epsilon</math>-NDFSM into equivalent DFSM.</p> <table border="1"><tr><td>Q</td><td><math>\epsilon</math></td><td>a</td><td>b</td><td>c</td></tr><tr><td>p</td><td>{q, r}</td><td><math>\phi</math></td><td>{q}</td><td>{r}</td></tr><tr><td>q</td><td><math>\phi</math></td><td>{p}</td><td>{r}</td><td>{p, q}</td></tr><tr><td><math>\star</math> r</td><td><math>\phi</math></td><td><math>\phi</math></td><td><math>\phi</math></td><td>{p}</td></tr></table>	Q	$\epsilon$	a	b	c	p	{q, r}	$\phi$	{q}	{r}	q	$\phi$	{p}	{r}	{p, q}	$\star$ r	$\phi$	$\phi$	$\phi$	{p}	10	(2 : 1 : 1.7.1)
Q	$\epsilon$	a	b	c																			
p	{q, r}	$\phi$	{q}	{r}																			
q	$\phi$	{p}	{r}	{p, q}																			
$\star$ r	$\phi$	$\phi$	$\phi$	{p}																			
		10	(3 : 1 : 1.7.1)																				
<b><u>Module-2</u></b>																							
3.	<p>a. Prove that every language defined by regular expression is also defined by Finite Automata.</p> <p>b. Design regular expression for the following languages (i) <math>L = \{a^m b^n : m+n \text{ is even} \}</math> (ii) <math>L = \{a^m b^n : m \geq 4, n \leq 3 \}</math> (iii) set of all strings of a's and b's which contain sub string abb</p> <p style="text-align: center;"><b>(OR)</b></p>	10	(2 : 2 : 1.7.1)																				
		10	(3 : 2 : 1.7.1)																				
4.	<p>a. Define tokens, patterns and lexemes with examples. Describe the two buffer scheme that handles large lookaheads safely.</p> <p>b. Convert the following regular expressions to equivalent DFSM: (i)<math>(a+b)^*ab</math> (ii)<math>(01+1)^*0</math> (iii) <math>(aa)^*+(bb)^*</math></p> <p style="text-align: center;"><b><u>Module-3</u></b></p>	10	(2 : 2 : 1.7.1)																				
		10	(3 : 2 : 1.7.1)																				
5.	<p>a. Write regular definition and transition diagram for the following tokens: (i) Identifier (ii) Number (iii) Relational operator</p> <p>b. What is Ambiguity? Show that the following Grammar is Ambiguous. <math>E \rightarrow E+E \mid E^*E \mid (E) \mid id</math> for the string <math>id+id*id</math></p> <p style="text-align: center;"><b>(OR)</b></p>	10	(3 : 3 : 1.7.1)																				
		10	(3 : 3 : 1.7.1)																				

6. a. Design CFG for the following languages: **10** (3 :3 : 1.7.1)  
 (i)  $L = \{a^{2n} b^m \mid n \geq 0, m \geq 0\}$  (ii) Set of all strings with equal number of a's and b's.  
 b. Consider the Grammar  $E \rightarrow E+E \mid E * E \mid (E) \mid id$ . Find Left most and rightmost derivation of and Parse tree for the string  $id + id * id$ . Show that the grammar is Ambiguous. **10** (3 :3 : 1.7.1)

#### Module-4

7. a. Design Push Down Automata. Design PDA for the following languages: **10** (3 :4 : 1.7.1)  
 “Set of all strings which consists of equal number of a's and b's”. Draw transition diagram.  
 b. Design NPDA for the following language: **10** (3 :4 : 1.7.1)  
 $L = \{w w^R \mid w \in \{0,1\}^*\}$

**(OR)**

8. a. Construct SLR parsing table for the following grammar: **10** (3 :5 : 1.7.1)  
 $A \rightarrow (A) \mid a$   
 b. Perform shift reduce parsing of input string  $id * id$  using following grammar: **10** (3:5 : 1.7.1)  
 $E \rightarrow E+T \mid T \quad T \rightarrow T * F \mid F \quad F \rightarrow (E) \mid id$   
 Explain conflicts which occur during shift reduce parsing.

#### Module-5

9. a. Design a TM for  $L = \{0^n 1^n 2^n \mid n \geq 0\}$ . Show the moves for 001122. **10** (3 :5 : 1.7.1)  
 b. Define Turing machine. Explain with a diagram the basic working of Turing machine. Briefly explain Instantaneous Description (ID). **10** (3 :5 : 1.7.1)
- (OR)**
10. a. Write the Syntax directed definition of a simple desk calculator and give annotated parse trees for the following expression:  $4 * 6 + 8$ . **10** (1 :1 : 1.7.1)  
 b. Construct the syntax tree and DAG for the following expression: **10** (1 :1 : 1.7.1)  
 $a + a * (b - c) + (b - c) * d$

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